



Published in final edited form as:

*Am J Prev Med.* 2019 August ; 57(2): 145–152. doi:10.1016/j.amepre.2019.03.014.

## Causes of Excess Mortality in Veterans Treated for Posttraumatic Stress Disorder

Jenna A. Forehand, MD, MPH<sup>1</sup>, Talya Peltzman, MPH<sup>1</sup>, Christine Leonard Westgate, MS<sup>1</sup>, Natalie B. Riblet, MD, MPH<sup>1,2,3</sup>, Bradley V. Watts, MD, MPH<sup>1,2,4</sup>, and Brian Shiner, MD, MPH<sup>1,2,3,5</sup>

<sup>1</sup>Veterans Affairs Medical Center, White River Junction, Vermont

<sup>2</sup>Department of Psychiatry, Geisel School of Medicine, Hanover, New Hampshire

<sup>3</sup>The Dartmouth Institute for Health Policy and Clinical Practice, Lebanon, New Hampshire

<sup>4</sup>Fellowships in Quality and Safety, National Center for Patient Safety, Ann Arbor, Michigan

<sup>5</sup>National Center for Posttraumatic Stress Disorder, White River Junction, Vermont

### Abstract

**Introduction:** Published research indicates that posttraumatic stress disorder (PTSD) is associated with increased mortality. However, causes of death among treatment-seeking PTSD patients remain poorly characterized. The study objective was to describe causes of death among PTSD patients to inform preventive interventions for this treatment population.

**Methods:** A retrospective cohort study was conducted of all veterans who initiated PTSD treatment at any Department of Veterans Affairs Medical Center from fiscal year 2008–2013. The primary outcome was mortality within the first year after treatment initiation. In 2018, the collected data was analyzed to determine leading causes of death. For the top 10 causes, standardized mortality ratios (SMRs) were calculated from age- and sex-matched mortality tables of the U.S. general population.

**Results:** 491,040 veterans were identified who initiated PTSD treatment. Mean age was 48.5 years (+/– 16.0 years), 90.7% were male, and 63.5% were of white race. In the year following treatment initiation, 1.1% (5,215/491,040) died. All-cause mortality was significantly higher for veterans with PTSD compared to the U.S. population (SMR 1.05, 95% CI: 1.02–1.08,  $p < 0.001$ ). Veterans with PTSD had a significant increase in mortality from suicide (SMR 2.52, CI: 2.24–2.82,  $p < 0.001$ ), accidental injury (SMR 1.99, CI: 1.83–2.16,  $p < 0.001$ ) and viral hepatitis (SMR 2.26, CI: 1.68–2.93,  $p < 0.001$ ) compared to the U.S. population. Of those dying from accidental injury, more than half died of poisoning (52.3%, 325/622).

---

**Corresponding Author:** Jenna A. Forehand, MD, MPH, National Center for Patient Safety Field Office, Veterans Affairs Medical Center (10E2E), 215 North Main Street, White River Junction, VT 05009, jenna.forehand@va.gov, 802-295-9363 ext. 5222.

**Presentation disclosure:** The article contents have not been previously presented elsewhere.

**Financial disclosure:** No financial disclosures were reported by the authors of this paper.

**Additional information:** The VA Corporate Data Warehouse (CDW) contains electronic medical record data compiled from individual VA facilities and is described at [http://www.hsrp.research.va.gov/for\\_researchers/vinci/cdw.cfm](http://www.hsrp.research.va.gov/for_researchers/vinci/cdw.cfm). Researchers with VA network access can obtain descriptions of CDW data at <http://vaww.virec.research.va.gov/>.

**Conclusions:** Veterans with PTSD have an elevated risk of death from suicide, accidental injury and viral hepatitis. Preventive interventions should target these important causes of death.

## INTRODUCTION

Posttraumatic stress disorder (PTSD) is a condition that develops after exposure to a traumatic event.<sup>1</sup> Symptoms include intrusive re-experiencing of the traumatic event, avoidance of trauma-related stimuli, negative alterations in cognition and mood, and changes in arousal and reactivity.<sup>1</sup> PTSD affects 8.3% of Americans<sup>2</sup> and is marked by significant symptom-related distress and functional impairment.<sup>3</sup> In addition to decreased quality of life,<sup>3</sup> individuals with PTSD suffer from increased rates of cardiovascular,<sup>4</sup> metabolic,<sup>5</sup> and autoimmune disorders<sup>6</sup> when compared to those without PTSD. These factors taken in aggregate possibly make PTSD an important contributor to mortality, and therefore a priority for preventive healthcare.

While literature strongly supports the assertion that PTSD patients have increased overall mortality, the exact cause or causes of that excess mortality has been more elusive. Understanding these causes may help elucidate potential targets for prevention. Most studies evaluating mortality in PTSD have been conducted in U.S. military veterans. While veterans with PTSD have been documented to have twice the risk of death as those without PTSD, the causes remain unknown.<sup>7</sup> Published reports frequently demonstrate causes of death attributed to cardiovascular complications<sup>7-12</sup> and malignancy,<sup>7,12</sup> but studies comparing Vietnam Veterans with PTSD to the general population have not found increased cardiovascular or malignancy-related deaths.<sup>13,14</sup> Other studies have reported a high prevalence of external cause mortality<sup>7,13-15</sup> among PTSD patients. However, with the exception of suicide mortality,<sup>7,13-18</sup> a detailed analysis of specific external causes of death in this population has not yet been published.

Most published reports about external causes of death focus on Vietnam Veterans with PTSD.<sup>7,12,14,17,19,20</sup> However, the limited research on external causes of death in other veteran cohorts has been less clear.<sup>17,20</sup> Veterans with PTSD who served in Operation Enduring Freedom (OEF), Operation Iraqi Freedom (OIF), or Operation New Dawn (OND) have not been widely studied. These contemporary cohorts have higher percentages of young veterans and women,<sup>21</sup> both of which may influence causes of death.<sup>22</sup> With advances in medicine and technology, OEF/OIF/OND Veterans are more likely to survive combat injuries than previous generations, thereby increasing the prevalence of PTSD,<sup>17,21</sup> pain disorder,<sup>23</sup> and pain-related opioid use<sup>23</sup> among survivors. Evaluating mortality across a diverse sample of veterans may provide more inclusive data on causes of death related to PTSD.

In addition, causes of death among patients engaged in clinical treatment for PTSD are not well described. Although published reports demonstrate an elevated all-cause mortality risk among treatment-seeking U.S. veterans with PTSD,<sup>13,24</sup> the treatment settings are rarefied (e.g. residential<sup>13</sup> and inpatient<sup>18</sup>) and generalizability to a larger PTSD treatment population may be limited. Furthermore, between 2004 and 2013, the Veterans Health Administration underwent a clinical paradigm shift in the management of PTSD<sup>25</sup> by

incorporating more individualized evidence-based psychotherapy into treatment plans.<sup>26</sup> Given the wide array of clinical manifestations and comorbidities associated with PTSD, access to tailored treatment modalities may have improved health outcomes among treatment-seeking veterans by addressing individual needs.<sup>18</sup>

Finally, the relationship between age and cause of death among patients with PTSD is not well known. Early research suggests that PTSD patients may have accelerated cellular aging as evidenced by shorter telomere lengths,<sup>27</sup> and may therefore, be at increased risk for death. This may be related to chronic stress states compounded over many years.<sup>13</sup> In a 6-year longitudinal study of Vietnam Veterans with PTSD, hyperarousal symptoms were found to significantly increase over time.<sup>18</sup> It is plausible that this hyperarousal could increase rates of cardiovascular disease and death among older patients with chronic PTSD. Evaluating causes of death relative to age in PTSD patients may be important for developing targeted interventions.

No study has comprehensively investigated specific causes of death by age group among contemporary treatment-seeking veterans with PTSD and compared mortality rates to an age- and gender-matched U.S. general population. Stratifying causes of death by age may help determine if mortality related to chronic stress states appears later in life. The purpose of this study was to better understand the relationship between PTSD and mortality among a national sample of treatment-seeking veterans with PTSD. The primary objectives were: 1) to document the relative mortality for veterans engaging in PTSD treatment compared to the U.S. population, and 2) to determine the specific causes of death contributing to this mortality thereby informing preventive interventions for patients and providers.

## METHODS

### Data Source

VA users with new PTSD treatment episodes between fiscal years (FY) 2008 and 2013 were identified using the VA Corporate Data Warehouse (CDW). Patient demographic information, encounter and diagnostic data were obtained from CDW. The Veterans Institutional Review Board of Northern New England approved the study.

### Study Population

Patients were drawn from an existing retrospective cohort of veterans entering PTSD treatment at a VA facility (VA users) between October 1, 2008 and September 30, 2013.<sup>28,29</sup> To avoid misclassification of PTSD status in VA administrative data, VA users were included who received a primary diagnosis of PTSD at two or more outpatient visits, at least one of which occurred in a mental health setting, over the course of 90 days. Requiring at least two PTSD diagnoses<sup>30,31</sup> and using PTSD diagnoses made in mental health settings are both strategies to increase the positive predictive value of diagnostic data.<sup>30</sup> However, as access to individualized evidence-based psychotherapy for PTSD has only increased in clinical practice since 2008,<sup>32</sup> this dataset was restricted to veterans with new episodes of VA PTSD treatment in FY2008 or later. When veterans met inclusion criteria multiple times over the 6-

year period, only the first episode was included. Qualifying veterans were followed for one year after index PTSD diagnosis.

## Measures

To describe the cohort, patient and healthcare utilization characteristics were measured for FY2008–2013. Patient characteristics included demographics, medical and psychiatric comorbidities, and military service. Healthcare utilization characteristics included percentage of patients receiving outpatient visits to primary care, general mental health, specialized PTSD clinics, substance abuse specialty clinics, as well as residential PTSD programs, substance abuse programs, and acute inpatient psychiatry settings.

To assess mortality, vital status was obtained using the VA Vital Status File which is linked to the CDW. All deaths identified within one year of index PTSD diagnosis were assessed for cause of death using the VA-DoD Suicide Data Repository, which links VA decedents to the Centers for Disease Control and Prevention (CDC) National Death Index (NDI).<sup>33</sup> Cause of death was classified using ICD-10 definitions from the CDC National Center for Health Statistics.

To allow for statistical comparison with the general population, mortality rates for the 2014 U.S. population were extracted from CDC's Wide-Ranging Online Database for Epidemiologic Research (WONDER).<sup>34</sup> The CDC WONDER comparison population was classified by gender and three age categories (18–34, 35–64, and 65). For all-cause mortality and leading causes of death present in the study population, reference rates were obtained for age and sex specific strata to facilitate calculation of an age- and sex-adjusted SMR.

## Statistical Analysis

Between September 4, 2018 and November 2, 2018, the collected data was analyzed in two parts. Counts of death were generated for all causes of death for veterans in the first year of VA PTSD treatment from FY2008–2013. Following NDI data standards, categories were suppressed where counts of death dropped below 10. This method resulted in the presentation of up to 15 leading causes of death for the study population overall and for each age group. To compare the observed mortality among PTSD veterans to the U.S. population, age- and sex-adjusted SMRs were calculated for only the top 10 leading causes to ensure stable rates in the sub-strata. To generate a consistent comparison with CDC WONDER,<sup>34</sup> all deaths were counted for veterans who initiated VA PTSD treatment in calendar years (CY) 2008–2013. However, this timeframe shift did not change the rank-order of leading causes of death.

## RESULTS

Between FY2008 and 2013, a total of 491,040 veterans with PTSD met inclusion criteria for treatment initiation (Table 1). The mean age of veterans was 48.5 (+/- 16.0), 90.7% were male, 63.5% were white, and 60.1% were middle aged (35–64 y). In the year following index PTSD diagnosis, 60.3% were diagnosed with comorbid depression, 39% with nicotine dependence, 22.6% with alcohol dependence, and 3.2% with opioid dependence. Over one

third served in OEF/OIF/OND (34.9%) and many experienced combat (28.6%). Almost all utilized primary care (92.3%) and outpatient general mental health services (99.9%). Nearly half of veterans with PTSD visited outpatient specialized PTSD clinics (44.6%) with a smaller percentage entering residential PTSD treatment (2.1%) or inpatient mental health (7%).

### Descriptive Analyses

During the first year of VA PTSD treatment, 5,215 veterans died (Table 2). The top three causes of death were heart disease, malignant neoplasms and unintentional injury. The leading causes of death for young veterans (18–34 y) were unintentional injury and suicide. The leading causes of death for middle-aged veterans (35–64 y) and older veterans (≥ 65 y) were heart disease and malignant neoplasms.

Given that 622 veterans with PTSD died from unintentional injury during their first year of treatment, these injury-related deaths were further described (Table 3). In the full population, the top three causes of unintentional injury deaths were poisoning, motor vehicle traffic, and falls. The leading causes of unintentional injury deaths in young veterans and middle-aged veterans were poisoning and motor vehicle traffic. The leading causes of unintentional injury deaths in older veterans were falls and motor vehicle traffic.

### Comparison with the United States General Population

Between CY2008 and 2013, a total of 473,803 veterans entered VA PTSD treatment and 4,782 died within 1 year. Based on the age- and gender-matched U.S. population, 4,553.7 deaths were expected due to any cause. Therefore, there was evidence of excess mortality among veterans with PTSD compared to the U.S. population (SMR 1.05, 95% CI: 1.02–1.08,  $p < 0.001$ ).

Veterans with PTSD had a significant increase in mortality compared to the U.S. population for several causes of death (Table 4), including diabetes mellitus (SMR 1.29, CI: 1.11–1.49,  $p < 0.001$ ) and chronic liver disease (SMR 1.34, CI: 1.11–1.59,  $p < 0.01$ ). Importantly, veterans with PTSD had a two-fold increase in mortality compared to the U.S. population for suicide (SMR 2.52, CI: 2.24–2.82,  $p < 0.001$ ), unintentional injury (SMR 1.99, CI: 1.83–2.16,  $p < 0.001$ ), and viral hepatitis (SMR 2.26, CI: 1.68–2.93,  $p < 0.001$ ). Conversely, among those with PTSD, there were fewer than expected deaths from cerebrovascular disease (SMR 0.54, CI: 0.44–0.65,  $p < 0.001$ ) and malignant neoplasms (SMR 0.90, CI: 0.85–0.96,  $p < 0.001$ ).

## DISCUSSION

This study outlined specific causes of excess mortality among veterans with PTSD and stratified those causes of death by age. Compared to the U.S. population, VA users engaging in PTSD treatment had a 5% excess risk for death due to any cause. Importantly, accidents, suicide and viral hepatitis were most elevated as causes of death compared to the U.S. population, with SMRs indicating a 2-fold increase in mortality for each cause of death. Diabetes mellitus and chronic liver disease were also significantly elevated as causes of death compared to the U.S. population. During the first year of VA treatment, young veterans with PTSD were more likely to die from unintentional injury and suicide, whereas

middle-aged and older veterans were more likely to die from cardiovascular disease and malignant neoplasms.

The overall results support prior literature demonstrating an association between PTSD and excess mortality. However, the findings in this study showing a 5% excess mortality were smaller than Schlenger et al.'s finding of a 2-fold elevated risk,<sup>7</sup> and Meier et al.'s finding of a 58% elevated risk.<sup>15</sup> This divergence may be attributed to the selection of all-era veterans, including a large proportion of young veterans, across a range of PTSD treatment settings. Veterans seeking treatment for PTSD may be more inclined to seek treatment for other medical conditions, thereby mitigating potential risk factors associated with mortality.

The finding that veterans with PTSD were at elevated risk for death by suicide is consistent with prior literature.<sup>16</sup> While this finding was potentially mediated by elevated rates of depression and substance abuse,<sup>35</sup> it does not change the fact that veterans with PTSD were at risk for suicide. This study also demonstrated that excess mortality in PTSD patients was largely attributed to unintentional injuries, especially among young veterans. This relationship has not been previously well explored. While Meier et al. found that patients with PTSD had a significantly higher mortality risk due to external causes, they did not distinguish between accidents and suicide.<sup>15</sup> The majority of unintentional injury deaths observed in this study were the result of poisoning. Given the ongoing concerns regarding potential misclassification of suicides, especially overdose deaths,<sup>36</sup> it may be that some of the unintentional poisonings in this cohort were in fact misclassified suicides.

Veterans with PTSD were at significantly elevated risk for death due to diabetes mellitus and chronic liver disease, which is consistent with mounting evidence to support that PTSD may be associated with metabolic disorders.<sup>8,9</sup> Patients with PTSD are prone to engage in unhealthy behaviors (22.6% of this cohort had alcohol dependence) that increase their risk for liver disease. Like Bullman et al.<sup>14</sup> and Drescher et al.<sup>13</sup> who used general population comparators, this study did not find a significantly elevated risk for death due to cardiovascular disease or malignancy among veterans with PTSD compared to the U.S. population.

Although veterans with PTSD were at elevated risk for death from viral hepatitis compared to the U.S. population, there has been relatively little study of the relationship between blood-borne pathogens and PTSD. Yet, similar to this study, Essock et al. reported that PTSD was associated with a significant risk for HIV as well as hepatitis B and C.<sup>37</sup> This finding may correlate with increasing frequency of opioid use disorder among veterans (3.2% of this cohort had opioid dependence) with PTSD.<sup>23,29</sup> This is relevant given the documented association between opioid injection and hepatitis C.<sup>38</sup>

This study has important implications for preventive medicine. Although screening benefits must be weighed against the probability of adverse outcomes without screening,<sup>39</sup> patients with PTSD require greater utilization of healthcare<sup>40</sup> due to impaired functionality and comorbid medical and psychiatric illness.<sup>41</sup> It may therefore be less costly to intervene early. The VA currently has a PTSD screening process in place<sup>42</sup> and valid measures of PTSD diagnosis,<sup>30,31,43</sup> however less consensus regarding PTSD screening exists in the civilian



population.<sup>44</sup> Research is needed to determine if screening instruments, like the VA Primary Care PTSD Screen,<sup>42</sup> can help identify at-risk civilians. Moreover, research is needed to address the comorbidities that contribute to mortality in patients with PTSD.

The intersection of pain and PTSD may have significant clinical and programmatic implications, particularly for veterans with PTSD. Although the CDC recently issued guidelines emphasizing non-pharmacological treatments for pain disorder,<sup>45</sup> veterans with PTSD and comorbid pain may be at risk for opioid use disorder.<sup>23</sup> In addition to increasing the risk for hepatitis, opioids may play a role in unintentional injury and suicide, especially among 18–34 year old veterans with PTSD. Preventive efforts may need to focus on pain control as a possible target for PTSD treatment in this age group.

Treatment-seeking PTSD patients may also benefit from more seamless transitions between care settings.<sup>13</sup> Among Vietnam Veterans in residential PTSD treatment, Drescher et al. found that the average time from discharge to death was only 4 years.<sup>13</sup> Close follow-up, cross provider communication, and community integration<sup>41</sup> may be effective strategies to prevent PTSD-related deaths. However, more research is needed to determine if evidence-based PTSD care impacts mortality in this patient population.

## Limitations

This study has several limitations, primarily related to sample selection and follow-up. First, the approach did not account for relevant confounders including race/ethnicity, psychiatric and medical comorbidity, and treatment. While the cohort was started in 2008 to account for changes in VA delivery of evidence-based PTSD care, this study did not address patient-level treatment characteristics and was not designed to determine whether PTSD care effects mortality. Additional multiyear longitudinal cohorts are required to assess whether implementation of evidence-based psychotherapy for PTSD had an effect on mortality outcomes for VA users with PTSD.

Second, the results were not stratified based on military service, time from military separation to index PTSD diagnosis, area of deployment, exposure to theater of war, or trauma source. It is conceivable that each of these variables may impact PTSD severity and mitigate or worsen mortality risk. Third, the results only apply to the first year after PTSD diagnosis. Therefore, the influence of PTSD on disease may appear less severe than in subsequent years. Fourth, the PTSD cohort was included in the reference group (U.S. population) for SMR calculations. As a result, SMRs likely underestimate the differences between observed and expected deaths.

Finally, the study population was limited to U.S. veterans. The veteran population has demonstrated characteristics that make it unique from other PTSD populations.<sup>46</sup> Notably, veterans are predominantly older males.<sup>46</sup> Veterans who access the VA healthcare system are more likely to have poorer health, lower socioeconomic status, and more medical conditions than the general population.<sup>46</sup> Therefore, these findings may not be generalizable to civilians with PTSD. It will be important that other studies replicate these results in non-veteran populations and adjust for relevant confounders.

## CONCLUSIONS

The findings suggest that veterans with PTSD are at elevated risk for death compared to the general population, although the risk is smaller than in previous studies. More importantly, this study fills several gaps in the literature.

The risk for death from suicide and accidents is high in veterans with PTSD, especially among younger veterans. Veterans with PTSD and comorbid alcohol use disorder have even greater rates of suicide.<sup>47</sup> Treatment of PTSD as well as co-occurring depression and substance use disorders may lessen the risk of suicide. Similarly, interventions that target PTSD and comorbid pain disorder may reduce opioid-related suicide and accidental poisoning.<sup>23</sup>

The risk for death from diabetes, chronic liver disease, and viral hepatitis is also high in veterans with PTSD. These conditions are associated with unhealthy lifestyle choices. Therefore, PTSD patients should receive comprehensive education on the benefits of diet and exercise, and the risks of chronic stress and substance use.

Finally, future studies should focus on developing and testing targeted interventions to address these risk factors in order to improve the overall health outcomes in patients with PTSD.

## ACKNOWLEDGEMENTS

**Funding:** This work was funded by the VA National Center for Patient Safety Center of Inquiry Program (PSCI-WRJ-SHINER). Dr. Riblet is the recipient of a VA New England Early Career Development Award (VICDA-17-06). Dr. Shiner is the recipient of a VA Health Services Research and Development Career Development Award (CDA11-263).

**Conflict of Interest:** This work was supported by the VA National Center for Patient Safety Center of Inquiry Program (PSCI-WRJ-SHINER). Dr. Riblet is the recipient of a VA New England Early Career Development Award (VICDA-17-06). Dr. Shiner is the recipient of a VA Health Services Research and Development Career Development Award (CDA11-263). The sponsors had no role in the study design, methods, analysis, and interpretation of results or in the preparation of the manuscript and the decision to submit it for publication.

**Role of the sponsor:** The sponsors had no role in the study design, methods, analysis, and interpretation of results or in the preparation of the manuscript and the decision to submit it for publication.

## REFERENCES

1. American Psychiatric Association. Trauma and stressor-related disorders In: Diagnostic and Statistical Manual of Mental Disorders. 5th ed. Arlington, VA: American Psychiatric Association; 2013.
2. Kilpatrick DG, Resnick HS, Milanak ME, et al. National estimates of exposure to traumatic events and PTSD prevalence using DSM-IV and DSM-V criteria. *J Trauma Stress*. 2013;26(5):537–547. 10.1002/jts.21848. [PubMed: 24151000]
3. Fang SC, Schnurr PP, Kulish AL, et al. Psychosocial functioning and health-related quality of life associated with posttraumatic stress disorder in male and female Iraq and Afghanistan War Veterans: the VALOR registry. *J Womens Health (Larchmt)*. 2015;24(12):1038–1046. 10.1089/jwh.2014.5096. [PubMed: 26204466]
4. Beristianos MH, Yaffe K, Cohen B, Byers AL. PTSD and risk of incident cardiovascular disease in aging veterans. *Am J Geriatr Psychiatry*. 2016;24(3):192–200. 10.1016/j.jagp.2014.12.003. [PubMed: 25555625]



5. Rosenbaum S, Stubbs B, Ward PB, et al. The prevalence and risk of metabolic syndrome and its components among people with posttraumatic stress disorder: a systematic review and meta-analysis. *Metabolism*. 2015;64(8):926–933. 10.1016/j.metabol.2015.04.009. [PubMed: 25982700]
6. O'Donovan A, Cohen BE, Seal KH, et al. Elevated risk for autoimmune disorders in Iraq and Afghanistan Veterans with posttraumatic stress disorder. *Biol Psychiatry*. 2015;77(4):365–374. 10.1016/j.biopsych.2014.06.015. [PubMed: 25104173]
7. Schlenger WE, Corry NH, Williams CS, et al. A prospective study of mortality and trauma-related risk factors among a nationally representative sample of Vietnam Veterans. *Am J Epidemiol*. 2015;182(12):980–990. 10.1093/aje/kwv217. [PubMed: 26634285]
8. Cohen BE, Marmar C, Ren L, Bertenthal D, Seal KH. Association of cardiovascular risk factors with mental health diagnoses in Iraq and Afghanistan War Veterans using VA health care. *JAMA*. 2009;302(5):489–492. 10.1001/jama.2009.1084. [PubMed: 19654382]
9. Edmondson D, Cohen BE. Posttraumatic stress disorder and cardiovascular disease. *Prog Cardiovasc Dis*. 2013;55(6):548–556. 10.1016/j.pcad.2013.03.004. [PubMed: 23621964]
10. Ahmadi N, Hajsadeghi F, Mirshkarlo HB, et al. Post-traumatic stress disorder, coronary atherosclerosis, and mortality. *Am J Cardiol*. 2011;108(1):29–33. 10.1016/j.amjcard.2011.02.340. [PubMed: 21530936]
11. Xue Y, Taub PR, Iqbal N, et al. Cardiac biomarkers, mortality, and post-traumatic stress disorder in military veterans. *Am J Cardiol*. 2012;109(8):1215–1218. 10.1016/j.amjcard.2011.11.063. [PubMed: 22305506]
12. Boscarino JA. Posttraumatic stress disorder and mortality among U.S. Army Veterans 30 years after military service. *Ann Epidemiol*. 2006;16(4):248–256. 10.1016/j.annepidem.2005.03.009. [PubMed: 16099672]
13. Drescher KD, Rosen CS, Burling TA, Foy DW. Causes of death among male veterans who received residential treatment for PTSD. *J Trauma Stress*. 2003;16(6):535–543. 10.1023/b:Jots.0000004076.62793.79. [PubMed: 14690350]
14. Bullman TA, Kang HK. Posttraumatic stress disorder and the risk of traumatic deaths among Vietnam Veterans. *J Nerv Ment Dis*. 1994;182(11):604–610. [PubMed: 7964667]
15. Meier SM, Mattheisen M, Mors O, et al. Increased mortality among people with anxiety disorders: total population study. *Br J Psychiatry*. 2016;209(3):216–221. 10.1192/bjp.bp.115.171975. [PubMed: 27388572]
16. Gradus JL. Posttraumatic stress disorder and death from suicide. *Curr Psychiatry Rep*. 2018;20(11):98. 10.1007/s11920-018-0965-0. [PubMed: 30221328]
17. Boscarino JA. External-cause mortality after psychological trauma: the effects of stress exposure and predisposition. *Compr Psychiatry*. 2006;47(6):503–514. 10.1016/j.comppsy.2006.02.006. [PubMed: 17067875]
18. Johnson DR, Fontana A, Lubin H, Corn B, Rosenheck R. Long-term course of treatment-seeking Vietnam Veterans with posttraumatic stress disorder: mortality, clinical condition, and life satisfaction. *J Nerv Ment Dis*. 2004;192(1):35–41. 10.1097/01.nmd.0000105998.90425.6a. [PubMed: 14718774]
19. Boscarino JA. Psychobiologic predictors of disease mortality after psychological trauma: implications for research and clinical surveillance. *J Nerv Ment Dis*. 2008;196(2):100–107. 10.1097/NMD.0b013e318162a9f5. [PubMed: 18277217]
20. Bullman TA, Kang HK, Watanabe KK. Proportionate mortality among US Army Vietnam Veterans who served in military region I. *Am J Epidemiol*. 1990;132(4):670–674. [PubMed: 2403107]
21. Fulton JJ, Calhoun PS, Wagner HR, et al. The prevalence of posttraumatic stress disorder in Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) Veterans: a meta-analysis. *J Anxiety Disord*. 2015;31:98–107. 10.1016/j.janxdis.2015.02.003. [PubMed: 25768399]
22. Schnurr PP, Friedman MJ, Bernardy NC. Research on posttraumatic stress disorder: epidemiology, pathophysiology, and assessment. *J Clin Psychol*. 2002;58(8):877–889. 10.1002/jclp.10064. [PubMed: 12115712]
23. Seal KH, Shi Y, Cohen G, et al. Association of mental health disorders with prescription opioids and high-risk opioid use in U.S. Veterans of Iraq and Afghanistan. *JAMA*. 2012;307(9):940–947. 10.1001/jama.2012.234. [PubMed: 22396516]

24. KasproW WJ, Rosenheck R. Mortality among homeless and nonhomeless mentally ill veterans. *J Nerv Ment Dis.* 2000;188(3):141–147. [PubMed: 10749278]
25. Rosen CS, Matthieu MM, Wiltsey Stirman S, et al. A review of studies on the system-wide implementation of evidence-based psychotherapies for posttraumatic stress disorder in the Veterans Health Administration. *Adm Policy Ment Health.* 2016;43(6):957–977. 10.1007/s10488-016-0755-0. [PubMed: 27474040]
26. Veterans Health Administration, Office of Quality Safety and Value, The Management of Posttraumatic Stress Disorder Working Group. VA/DoD clinical practice guidelines for the management of posttraumatic stress disorder and acute stress disorder. United States Departments of Veterans Affairs and Defense website; <https://www.healthquality.va.gov/guidelines/MH/ptsd/VADoDPTSDCPGFinal012418.pdf>. Accessed 10 25, 2018.
27. Li X, Wang J, Zhou J, Huang P, Li J. The association between post-traumatic stress disorder and shorter telomere length: a systematic review and meta-analysis. *J Affect Disord.* 2017;218:322–326. 10.1016/j.jad.2017.03.048. [PubMed: 28486180]
28. Shiner B, Westgate CL, Bernardy NC, Schnurr PP, Watts BV. Anticonvulsant medication use in veterans with posttraumatic stress disorder. *J Clin Psychiatry.* 2017;78(5):e545–e552. 10.4088/JCP.16m11031. [PubMed: 28570793]
29. Shiner B, Leonard Westgate C, Bernardy NC, Schnurr PP, Watts BV. Trends in opioid use disorder diagnoses and medication treatment among veterans with posttraumatic stress disorder. *J Dual Diagn.* 2017;13(3):201–212. 10.1080/15504263.2017.1325033. [PubMed: 28481727]
30. Gravely AA, Cutting A, Nugent S, et al. Validity of PTSD diagnoses in VA administrative data: comparison of VA administrative PTSD diagnoses to self-reported PTSD Checklist scores. *J Rehabil Res Dev.* 2011;48(1):21–30. [PubMed: 21328160]
31. Frayne SM, Miller DR, Sharkansky EJ, et al. Using administrative data to identify mental illness: what approach is best? *Am J Med Qual.* 2010;25(1):42–50. 10.1177/1062860609346347. [PubMed: 19855046]
32. Maguen S, Li Y, Madden E, et al. Factors associated with completing evidence-based psychotherapy for PTSD among veterans in a national healthcare system. *Psychiatry Res.* 2019 10.1016/j.psychres.201902027.
33. Center of Excellence for Suicide Prevention. Joint Department of Veterans Affairs (VA) and Department of Defense (DoD) Suicide Data Repository – National Death Index (NDI). In: Canandaigua, NY 2017.
34. Friede A, Reid JA, Ory HW. CDC WONDER: a comprehensive on-line public health information system of the Centers for Disease Control and Prevention. *Am J Public Health.* 1993;83(9):1289–1294. [PubMed: 8395776]
35. Conner KR, Bossarte RM, He H, et al. Posttraumatic stress disorder and suicide in 5.9 million individuals receiving care in the Veterans Health Administration health system. *J Affect Disord.* 2014;166:1–5. 10.1016/j.jad.2014.04.067. [PubMed: 25012403]
36. Rockett IRH, Smith GS, Caine ED, et al. Confronting death from drug self-intoxication (DDSI): prevention through a better definition. *Am J Prev Med.* 2014;104:e49–e55.
37. Essock SM, Dowden S, Constantine NT, et al. Risk factors for HIV, hepatitis B, and hepatitis C among persons with severe mental illness. *Psychiatr Serv.* 2003;54(6):836–841. 10.1176/appi.ps.54.6.836. [PubMed: 12773597]
38. Lake S, Kennedy MC. Health outcomes associated with illicit prescription opioid injection: a systematic review. *J Addict Dis.* 2016;35(2):73–91. 10.1080/10550887.2015.1127712. [PubMed: 26670724]
39. Harris R, Sawaya GF, Moyer VA, Calonge N. Reconsidering the criteria for evaluating proposed screening programs: reflections from four current and former members of the U.S. Preventive Services Task Force. *Epidemiol Rev.* 2011;33:20–35. 10.1093/epirev/mxr005. [PubMed: 21666224]
40. Schnurr PP, Friedman MJ, Sengupta A, Jankowski MK, Holmes T. PTSD and utilization of medical treatment services among male Vietnam Veterans. *J Nerv Ment Dis.* 2000;188(8):496–504. [PubMed: 10972568]

41. Wisco BE, Marx BP, Wolf EJ, et al. Posttraumatic stress disorder in the U.S. Veteran population: results from the National Health and Resilience in Veterans Study. *J Clin Psychiatry*. 2014;75(12):1338–1346. 10.4088/JCP.14m09328. [PubMed: 25551234]
42. Prins A, Bovin MJ, Smolenski DJ, et al. The Primary Care PTSD Screen for DSM-5 (PC-PTSD-5): development and evaluation within a veteran primary care sample. *J Gen Intern Med*. 2016;31(10):1206–1211. 10.1007/s11606-016-3703-5. [PubMed: 27170304]
43. Holowka DW, Marx BP, Gates MA, et al. PTSD diagnostic validity in Veterans Affairs electronic records of Iraq and Afghanistan Veterans. *J Consult Clin Psychol*. 2014;82(4):569–579. 10.1037/a0036347. [PubMed: 24731235]
44. Lang AJ, Stein MB. An abbreviated PTSD checklist for use as a screening instrument in primary care. *Behav Res Ther*. 2005;43(5):585–594. [PubMed: 15865914]
45. Dowell D, Haegerich TM, Chou R. CDC Guideline for Prescribing Opioids for Chronic Pain—United States, 2016. *JAMA*. 2016 4 19;315(15):1624–1645. 10.1001/jama.2016.1464. [PubMed: 26977696]
46. Agha Z, Lofgren RP, VanRuiswyk JV, Layde PM. Are patients at Veterans Affairs medical centers sicker? A comparative analysis of health status and medical resource use. *Arch Intern Med*. 2000;160(21):3252–3257. [PubMed: 11088086]
47. Straus E, Norman SB, Haller M, et al. Differences in protective factors among U.S. Veterans with posttraumatic stress disorder, alcohol use disorder, and their comorbidity: results from the National Health and Resilience in Veterans Study. *Drug Alcohol Depend*. 2018;194:6–12. 10.1016/j.drugalcdep.2018.09.011. [PubMed: 30390551]

**Table 1.**

Profile of VA Users with New Episodes of PTSD Care Between FY2008–2013

Variable	VA PTSD Veteran Cohort n=491,040	
	%	N
<b>Demographic Characteristics at Index PTSD Diagnosis</b>		
Age at Time of Care		
18–34 years	27.28	133,965
35–64 years	60.08	295,034
65 years	12.63	62,041
Sex		
Male	90.7	445,583
Female	9.3	45,457
Race		
White	63.5	311,756
Black	19.1	93,666
Hispanic	8.1	39,827
Married	52.7	258,764
Rural	35.0	171,644
Homeless	5.4	26,574
VA Disability Level 70	55.7	273,242
<b>Comorbidities During Year Following Index PTSD Diagnosis</b>		
Pain Disorder	64.9	318,802
Headache Disorder	25.1	123,441
TBI and Cognitive Disorders	13.4	65,834
Depressive Mood Disorders	60.3	296,071
Non-PTSD Anxiety Disorders	28.5	139,779
Bipolar Mood Disorders	6.2	30,560
<b>Substance Use Disorders During Year Following Index PTSD Diagnosis</b>		
Nicotine Dependence	39.0	191,712
Alcohol Dependence	22.6	111,027
Opioid Dependence	3.2	15,903
<b>Military Characteristics</b>		
OEF/OIF/OND Veteran <sup>a</sup>	34.9	171,364
Combat Exposure	28.6	140,344
Military Sexual Trauma	9.3	45,803
<b>Service Utilization During Year Following Index PTSD Diagnosis</b>		
Any Primary Care Visits	92.3	453,051
Any Outpatient General Mental Health Visits	99.9	490,511
Any Outpatient Specialized PTSD Clinic Visits	44.6	218,827
Any Outpatient Substance Abuse/Detox Visits	14.6	71,513
Any Residential PTSD Treatment	2.1	10,375

<i>Variable</i>	<b>VA PTSD Veteran Cohort n=491,040</b>	
	<b>%</b>	<b>N</b>
Any Residential Substance Abuse Treatment	2.6	12,723
Any Inpatient Mental Health Treatment	7.0	34,386

Legend: FY, fiscal year; PTSD, posttraumatic stress disorder; SD, standard deviation; TBI, traumatic brain injury; VA, U.S. Department of Veterans Affairs

<sup>a</sup>Operation Enduring Freedom, Operation Iraqi Freedom, Operation New Dawn

**Table 2.**

Causes of Death Among VA Users During First Year of PTSD Treatment Between FY2008–2013

Rank	Overall n=5,215		Age 18–34 n=417		Age 35–64 n=2,875		Age 65 n=1,923	
	Cause of Death	N	Cause of Death	N	Cause of Death	N	Cause of Death	N
1	Heart Disease	1243	Unintentional Injury	202	Heart Disease	671	Heart Disease	552
2	Malignant Neoplasms	1126	Suicide	115	Malignant Neoplasms	659	Malignant Neoplasms	457
3	Unintentional Injury	622	Heart Disease	20	Unintentional Injury	345	Chronic Lower Respiratory Disease	161
4	Suicide	311	Homicide	12	Suicide	174	Unintentional Injury	75
5	Chronic Lower Respiratory Disease	297	Malignant Neoplasms	10	Chronic Low Respiratory Disease	134	Diabetes Mellitus	68
6	Diabetes Mellitus	194			Diabetes Mellitus	125	Cerebrovascular	56
7	Liver Disease	130			Liver Disease	107	Influenza & Pneumonia	50
8	Cerebrovascular	118			Cerebrovascular	60	Alzheimer's Disease	42
9	Influenza & Pneumonia	79	8 Causes Suppressed: Less than 10 Cases		Viral Hepatitis	56	Nephritis	32
10	Viral Hepatitis	58			Septicemia	30	Septicemia	22
11	Septicemia	52			Influenza & Pneumonia	27	Liver Disease	22
12	Nephritis	51			Hypertension	24	Suicide	22
13	Alzheimer's Disease	44			Nephritis	19	Pneumonitis	20
14	Homicide	35			Homicide	19	Parkinson's Disease	19
15	Hypertension	32			Aortic Aneurysm	15	Benign Neoplasms	12

Legend: PTSD, posttraumatic stress disorder



**Table 3.**

Unintentional Injury Deaths Among VA Users During First Year of PTSD Treatment FY2008–2013

Rank	Overall n=622		Age 18–34 n=202		Age 35–64 n=345		Age 65 n=75	
	Cause of Death	N	Cause of Death	N	Cause of Death	N	Cause of Death	N
1	Poisoning	325	Poisoning	130	Poisoning	183	Fall	30
2	MV Traffic	149	MV Traffic	63	MV Traffic	72	MV Traffic	14
3	Fall	53			Fall	22	Poisoning	12
4	Other Deaths <sup>a</sup>	23			Drowning	16		
5	Drowning	22	5 Causes Suppressed: Less than 10 Cases		Other Deaths <sup>a</sup>	15		
6	Suffocation	17			Suffocation	13	6 Causes Suppressed: Less than 10 Cases	
7	Pedestrian	10						
8								
9								
10	6 Causes Suppressed: Less than 10 Cases				7 Causes Suppressed: Less than 10 Cases			
11								
12								
13								

Legend: MV, motor vehicle; PTSD, posttraumatic stress disorder

<sup>a</sup>Other Deaths include accidental injury by firearm, fire/burn, machinery, natural/environment, struck by or against

**Table 4.**Leading Causes of Death Among VA Users Compared to the General U.S. Population<sup>a</sup>

Rank	Cause of Death	VA PTSD Cohort	General Population		SMR <sup>b</sup>	95% CI	
		Rate per 100,000	Rate per 100,000	Observed Deaths			Expected Deaths
1	Diseases of Heart	243.1	255.1	1,152	1,137.3	1.01	0.96 – 1.07
2	Malignant Neoplasms	214.9	242.8	1,018	1,129.0	<b>0.90***</b>	0.85 – 0.96
3	Unintentional Injury (Accidents)	120.5	50.0	571	286.5	<b>1.99***</b>	1.83 – 2.16
4	Intentional Self-Harm (Suicide)	61.4	15.9	291	115.3	<b>2.52***</b>	2.24 – 2.82
5	Chronic Lower Respiratory Disease	56.1	60.0	266	239.9	1.11	0.98 – 1.25
6	Diabetes Mellitus	38.0	30.4	180	139.3	<b>1.29***</b>	1.11 – 1.49
7	Chronic Liver Disease and Cirrhosis	24.9	13.9	118	87.9	<b>1.34**</b>	1.11 – 1.59
8	Cerebrovascular Disease	22.0	54.8	104	191.2	<b>0.54***</b>	0.44 – 0.65
9	Influenza and Pneumonia	15.2	22.5	72	88.9	0.81	0.63 – 1.01
10	Viral Hepatitis	10.6	3.3	50	22.1	<b>2.26***</b>	1.68 – 2.93

Legend: CI, confidence interval; PTSD, posttraumatic stress disorder; SMR, standardized mortality ratio

<sup>a</sup>VA users were followed after initiation of PTSD treatment between calendar year 2008 and 2013

<sup>b</sup>Reference is age- and sex-matched general U.S. population rates available from 2014 CDC Wonder

Boldface indicates statistical significance (\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ )